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Ito et al.

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(54) **SHEET SEPARATING APPARATUS**

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CPC ***B65H 3/5223*** (2013.01); ***B65H 3/52*** (2013.01); *B65H 2405/1118* (2013.01)

(58) **Field of Classification Search**
CPC B65H 3/52; B65H 3/5223; B65H 3/5238; B65H 2405/1118
USPC 271/167
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,672,580	B2 *	1/2004	Shibata et al.	271/124
7,618,036	B2 *	11/2009	Ikeda	271/121
7,798,485	B2 *	9/2010	Tu et al.	271/125
8,424,867	B2 *	4/2013	Morisaki	271/121
8,905,398	B2 *	12/2014	Kotaka	271/121
2003/0062668	A1 *	4/2003	Shibata et al.	271/121
2004/0041332	A1 *	3/2004	Kamimura et al.	271/121
2006/0082043	A1	4/2006	Ikeda	
2009/0315253	A1 *	12/2009	Osakabe et al.	271/121
2010/0258407	A1 *	10/2010	Krause et al.	198/443
2012/0080836	A1 *	4/2012	Morisaki	271/121
2012/0292846	A1 *	11/2012	Kotaka	271/10.09
2013/0293938	A1 *	11/2013	Osakabe et al.	358/498

FOREIGN PATENT DOCUMENTS

JP	03026618	A *	2/1991	B65H 3/06
JP	06092501	A *	4/1994	B65H 3/52
JP	2006111397	A	4/2006	

* cited by examiner

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(57) **ABSTRACT**

A sheet separating apparatus includes: a stacking part including a sheet support surface; a separation roller; a flexible member; a holding member to which a second end portion of the flexible member is fixed and urging the second end portion toward the separation roller; and an abutting part abuttable on the flexible member at an intermediate position. The flexible member includes an auxiliary support surface, provided upstream from the intermediate position, configured to support a downstream end portion of a sheet supported on the sheet support surface in a conveying direction and bendable in a direction getting away from the separation roller, and a friction surface provided downstream from the intermediate position and faces the separation roller to be contactable with the separation roller for separating the sheet one at a time in cooperation with the separation roller.

20 Claims, 9 Drawing Sheets

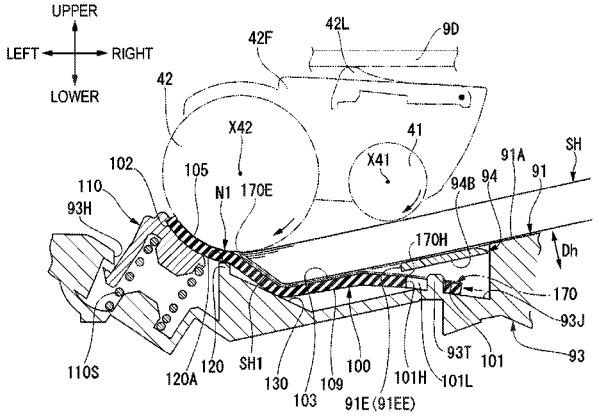


FIG. 1

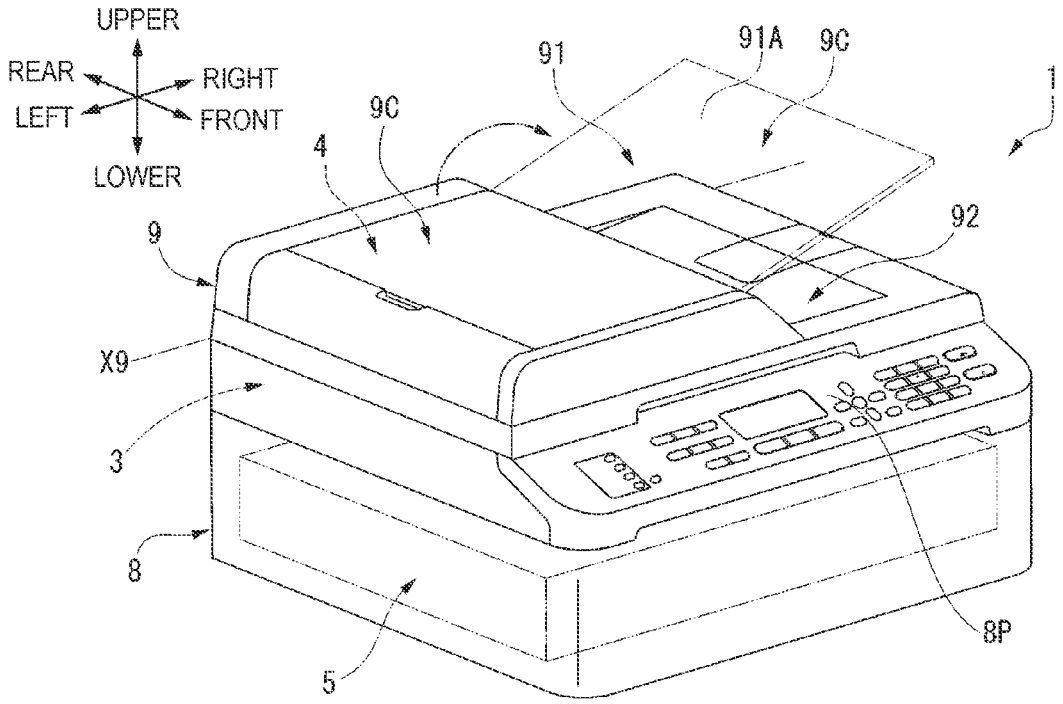
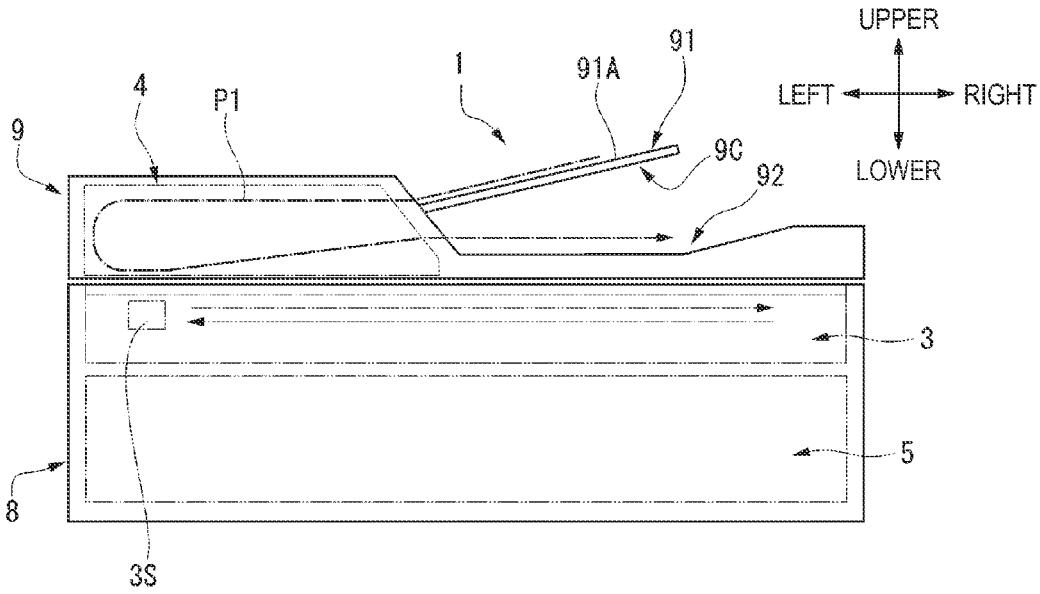


FIG. 2



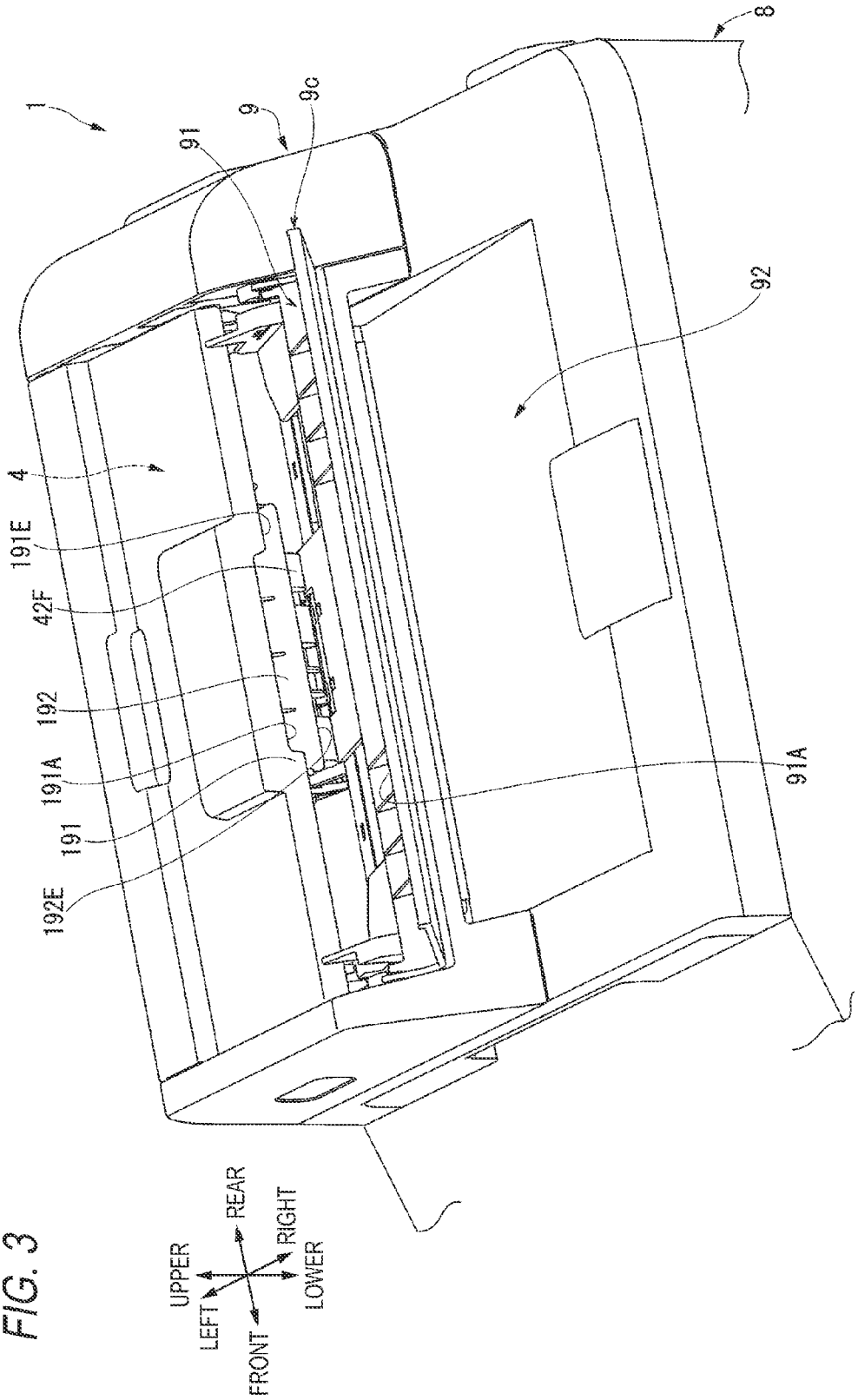

1
91
9
9c
8
92
4
191E
42F
192
191A
191
192E
91A
UPPER
LEFT
REAR
RIGHT
FRONT
LOWER

FIG. 3

FIG. 4

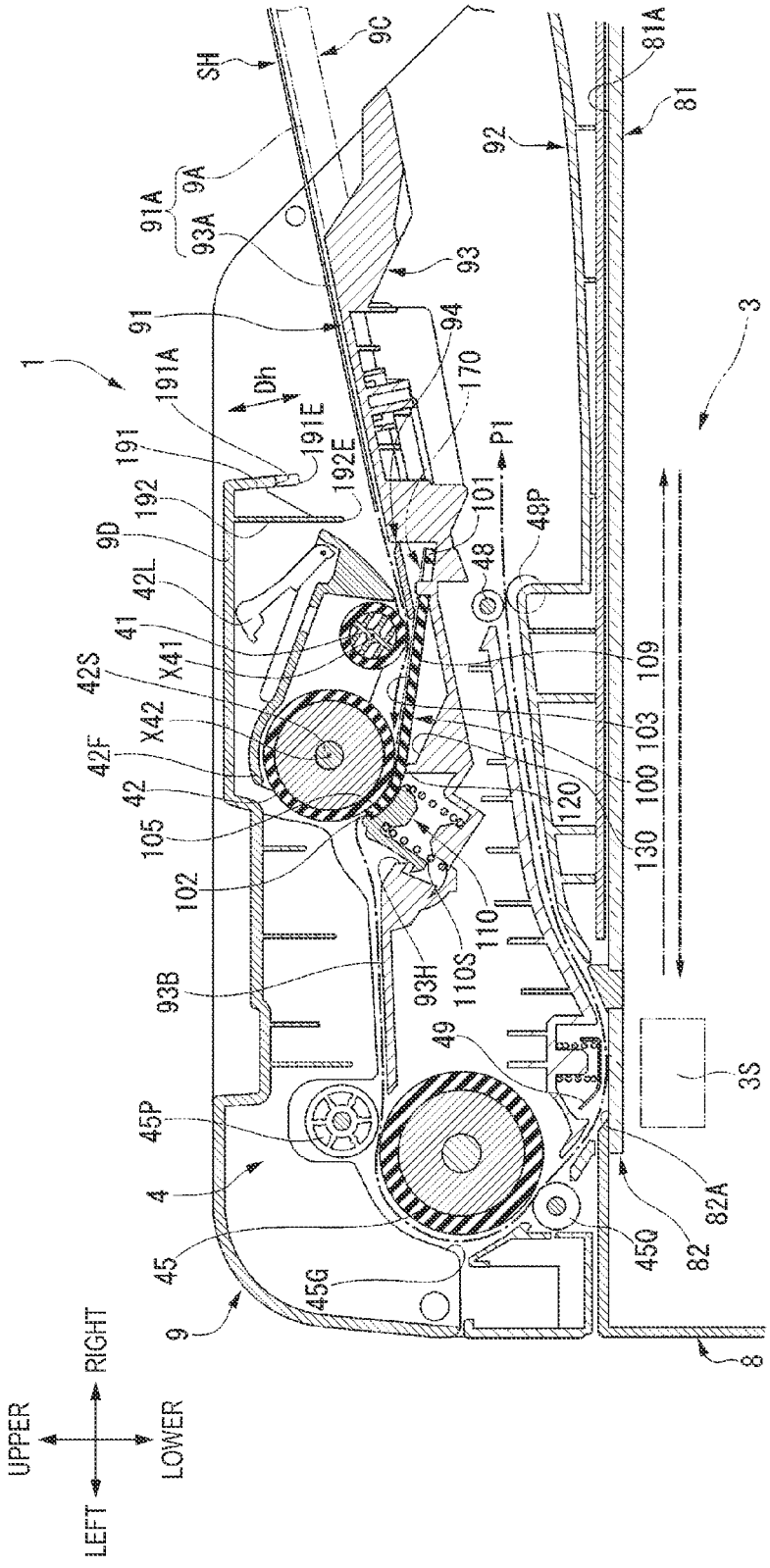
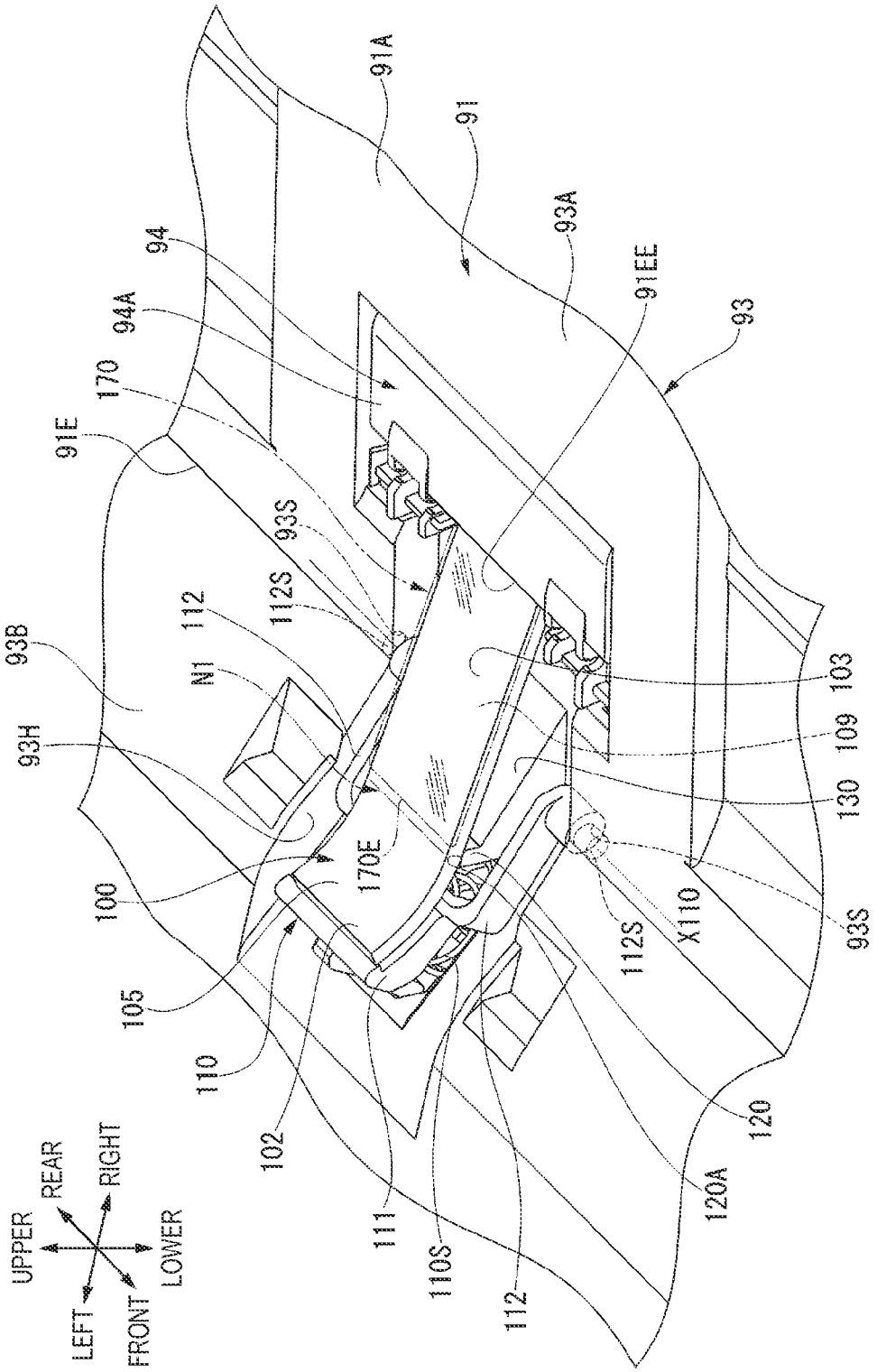

1
3
4
8
9
9A
9C
9D
SH
91
91A
93A
93
92
81
81A
94
170
191
191A
191E
192E
192
Dh
P1
101
48
48P
42L
41
X41
42S
X42
42F
42
105
102
109
103
100
120
130
110
110S
93H
93B
49
3S
45P
45
45G
450
82
82A
UPPER
LOWER
LEFT
RIGHT

FIG. 5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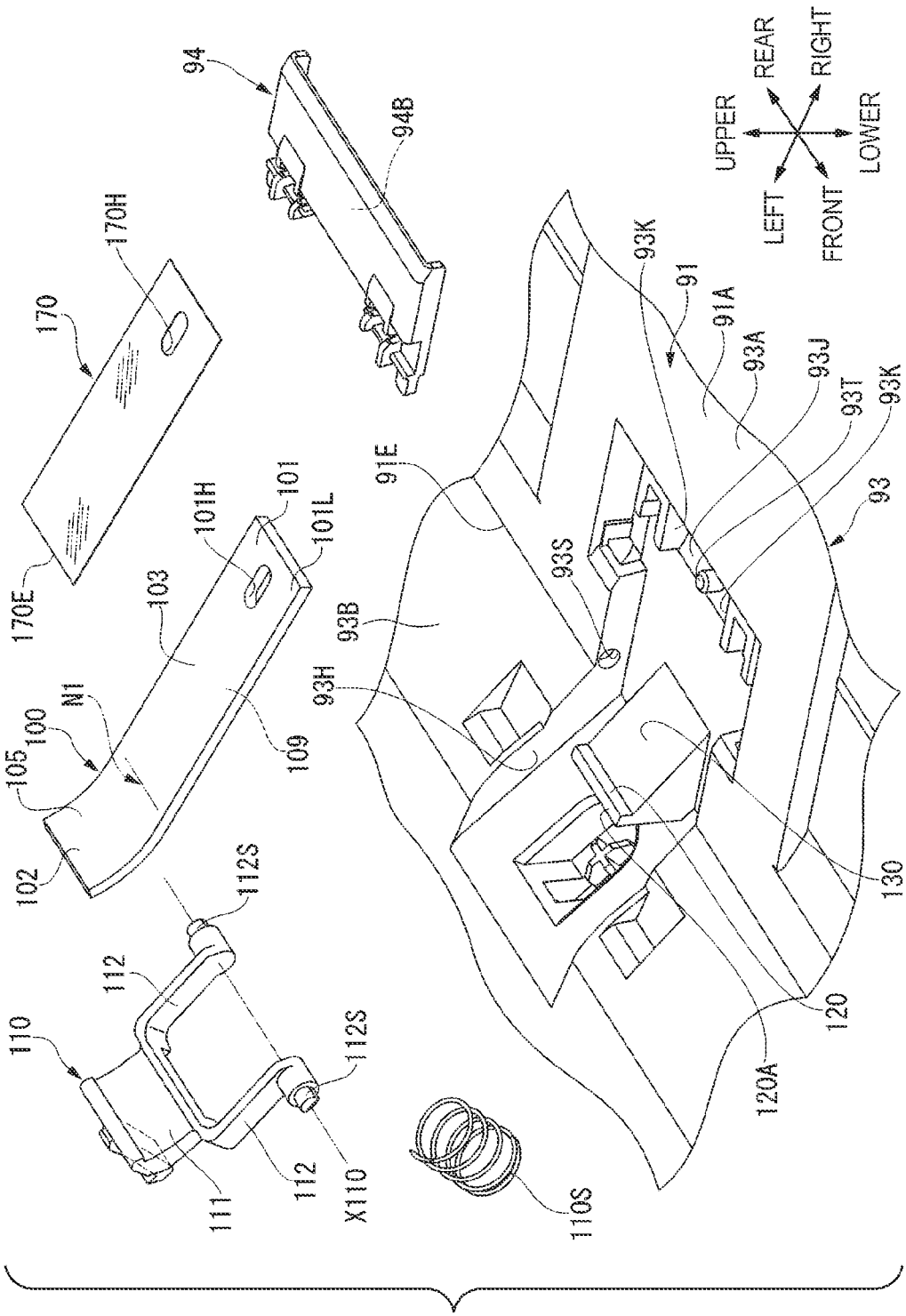
91
93A
91EE
93
94
94A
170
91E
93S
112S
112
N1
93B
93H
103
109
130
170E
100
105
110
102
111
110S
112
120
120A
X110
112S
93S
UPPER
REAR
RIGHT
LOWER
LEFT
FRONT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94B
170H
170
170E
101H
101
101L
103
N1
100
105
102
109
112S
112
110
111
112
X110
112S
110S
UPPER
REAR
RIGHT
LEFT
FRONT
LOWER
93K
91
91A
93A
93J
93T
93K
93
91E
93S
93B
93H
130
120
120A

FIG. 6

FIG. 7

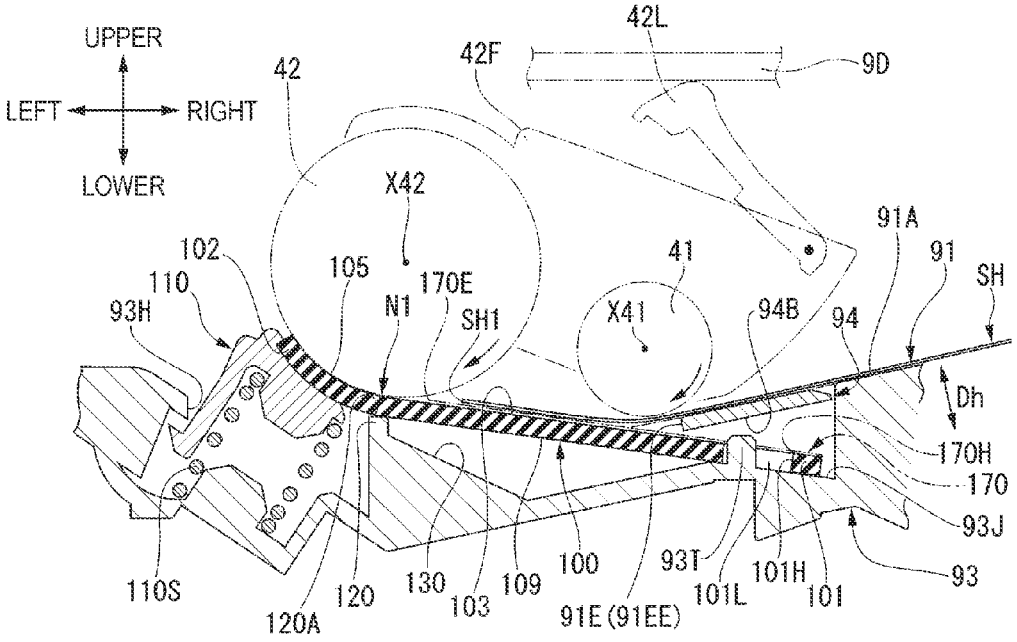

UPPER
LEFT
RIGHT
LOWER
42
42L
42F
9D
X42
91A
91
SH
102
110
93H
105
N1
170E
SH1
41
X41
94B
94
Dh
170H
170
93J
93
110S
120A
120
130
103
109
100
91E (91EE)
93T
101L
101H
101

FIG. 8

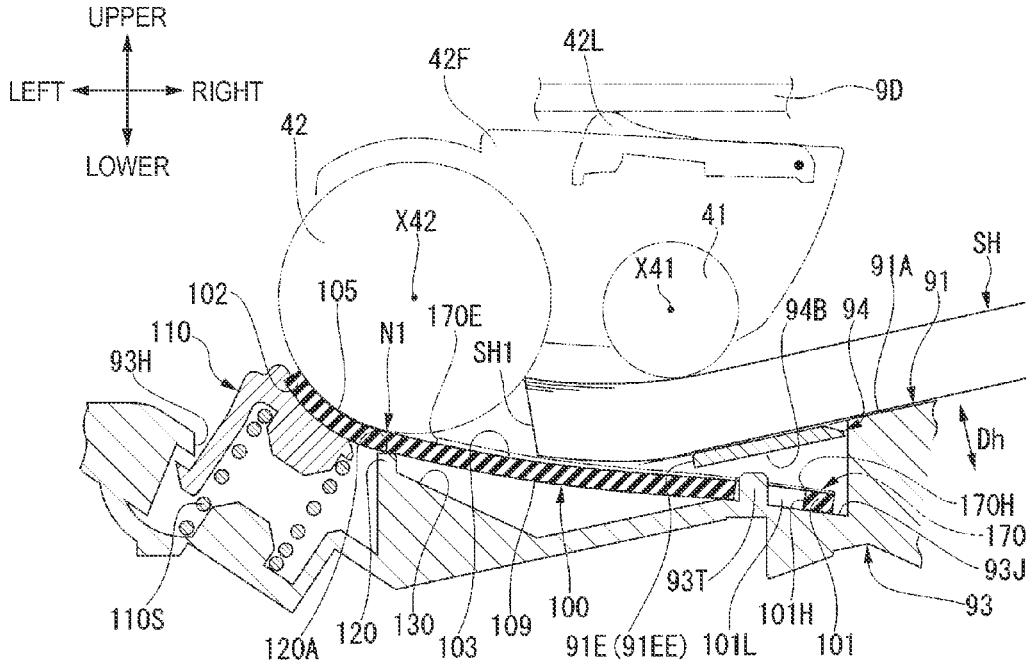
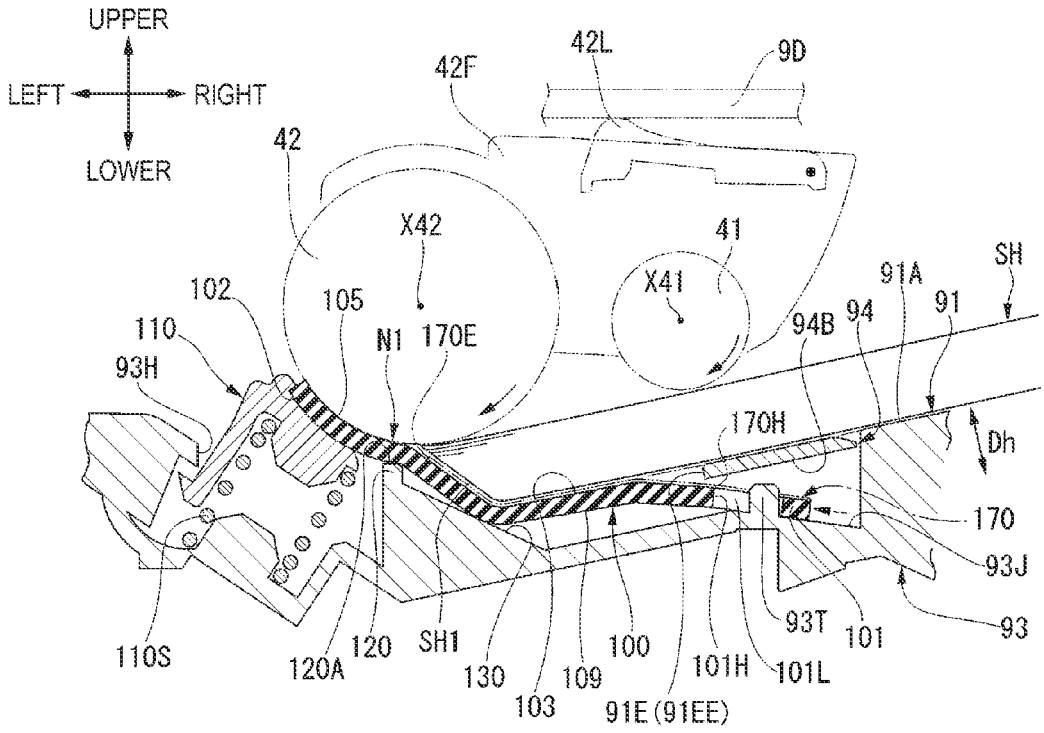

UPPER
LEFT
RIGHT
LOWER
42F
42L
9D
42
X42
41
X41
SH
91A
91
102
105
110
N1
170E
SH1
94B
94
93H
Dh
170H
170
93J
93
110S
120A
120
130
103
109
100
91E (91EE)
93T
101L
101H
101

FIG. 9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LEFT
RIGHT
LOWER
42
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42L
9D
X42
41
X41
SH
91A
91
94
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110
93H
N1
170E
170H
Dh
170
93J
93
93T
101
110S
120A
120
SH1
130
103
109
100
101H
101L
91E (91EE)

SHEET SEPARATING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority from Japanese Patent Application No. 2014-072002 filed on Mar. 31, 2014, the entire subject-matter of which is incorporated herein by reference.

TECHNICAL FIELD

The disclosure relates to a sheet separating apparatus.

BACKGROUND

There has been proposed a sheet separating apparatus. The sheet separating apparatus includes a stacking part, a separation roller, a separation pad serving as a flexible member, and a holding member.

The stacking part has a sheet support surface configured to support a sheet. The separation roller is configured to contact the sheet, which is fed from the stacking part, from an opposite side to the sheet support surface and to convey the sheet toward a downstream side in a conveying direction. The separation pad has flexibility. The separation pad includes a moveable first end portion positioned upstream in the conveying direction and a second end portion positioned downstream in the conveying direction and configured to face the separation roller. The second end portion of the separation pad is attached to the holding member. The holding member is configured to urge the second end portion of the separation pad toward the separation roller.

More specifically, the separation pad has an auxiliary support surface at an upstream side in the conveying direction, i.e., at the first end portion-side. The auxiliary support surface is configured to support a downstream end portion of the sheet, which is supported on the sheet support surface, in the conveying direction and to be bendable in a direction getting away from the separation roller. Also, the separation pad has a friction surface at a downstream side in the conveying direction, i.e., at the second end portion-side. The friction surface is configured to face the separation roller so that it can contact the separation roller, and is configured to separate the sheet one at a time in cooperation with the separation roller.

However, according to the related-art sheet separating apparatus, as the number of stacked sheets supported on the sheet support surface increases, the auxiliary support surface of the separation pad is bent in the direction getting away from the separation roller. Thereby, the bending of the auxiliary support surface influences the friction surface, thereby deforming the friction surface. For this reason, according to the sheet separating apparatus, when the sheet fed from the stacking part is nipped by the separation roller and the friction surface of the separation pad, the nipped state, for example, an inclined angle of the friction surface of the separation pad relative to the separation roller or a pressing force thereof is varied, so that the separation performance may be deteriorated. As a result, problems such as multi feed of sheets and unloaded feed of the sheet may occur in the sheet separating apparatus.

SUMMARY

Therefore, illustrative aspects of the disclosure provide a sheet separating apparatus capable of exhibiting stable separation performance, irrespective of whether the number of stacked sheets supported on a sheet support surface is large or small.

In one aspect of the disclosure, a sheet separating apparatus comprises: a stacking part including a sheet support surface configured to support a sheet; a separation roller configured to convey the sheet supported on the sheet support surface toward a downstream side in a conveying direction; a flexible member having flexibility and comprising: a first end portion positioned upstream in the conveying direction and being displaceable; and a second end portion positioned downstream in the conveying direction and facing the separation roller, a first surface of the flexible member facing the separation roller; a holding member to which the second end portion of the flexible member is attached; and an abutting part configured to abut on a second surface, which is opposite to the first surface, of the flexible member at an intermediate position between the first end portion and the second end portion in the conveying direction, wherein the flexible member comprises: an auxiliary support surface provided upstream from the intermediate position in the conveying direction and configured to support a downstream end portion of the sheet supported on the sheet support surface in the conveying direction, wherein the auxiliary support surface is bendable in a direction getting away from the separation roller; and a friction surface provided downstream from the intermediate position in the conveying direction and configured to face the separation roller to be contactable with the separation roller, wherein the friction surface is configured to separate the sheet one at a time in cooperation with the separation roller.

BRIEF DESCRIPTION OF THE DRAWINGS

The present disclosure is illustrated, and not limited, by way of example by the accompanying figures in which like reference numerals indicate similar elements.

FIG. **1** is a perspective view of an image reading apparatus of an illustrative embodiment;

FIG. **2** is a pictorial front view of the image reading apparatus of the illustrative embodiment;

FIG. **3** is a partial perspective view of an opening/closing unit of the image reading apparatus of the illustrative embodiment;

FIG. **4** is a pictorial partial sectional view of the image reading apparatus of the illustrative embodiment;

FIG. **5** is a partial perspective view of the image reading apparatus of the illustrative embodiment, which illustrates a feeder tray, a separation piece, a holding part, a film and the like;

FIG. **6** is an exploded perspective view of the image reading apparatus of the illustrative embodiment, which illustrates the feeder tray, the separation piece, the holding part, the film and the like;

FIG. **7** is a pictorial view of the image reading apparatus of the illustrative embodiment, which illustrates operations of an abutting part, an auxiliary support surface and a friction surface;

FIG. **8** is a pictorial view of the image reading apparatus of the illustrative embodiment, which illustrates operations of the abutting part, the auxiliary support surface and the friction surface; and

FIG. **9** is a pictorial view of the image reading apparatus of the illustrative embodiment, which illustrates operations of the abutting part, the auxiliary support surface and the friction surface.

DETAILED DESCRIPTION

Hereinafter, an illustrative embodiment will be described with reference to the drawings.

As shown in FIG. **1**, an image reading apparatus **1** of an illustrative embodiment is an example of a specific aspect of the sheet separating apparatus of the disclosure. In FIG. **1**, a side at which an operation panel **8**P is defined as a front side of the apparatus and a left side on the basis of the operation panel **8**P is defined as a left side, so that respective directions of front, rear, left, right, upper and lower are indicated. The respective directions denoted in FIG. **2** and thereafter are indicated in correspondence to the respective directions denoted in FIG. **1**. Hereinafter, the respective constitutional elements of the image reading apparatus **1** will be described on the basis of FIG. **1** and the like.

<Configuration>

As shown in FIGS. **1** to **4**, the image reading apparatus **1** includes a main body unit **8**, an opening/closing unit **9**, an image forming unit **5**, a reading unit **3**, a feeder tray **91**, a discharge tray **92** and a conveyor **4**. The main body unit **8** is a substantially flat box-shaped member. As shown in FIG. **1**, a front surface of the main body unit **8** is provided with the operation panel **8**P such as a touch panel.

As shown in FIGS. **1** and **2**, the image forming unit **5** is accommodated at a lower part in the main body unit **8**. The image forming unit **5** is configured to form an image on a sheet by an inkjet or laser way. The reading unit **3** is accommodated at an upper part in the main body unit **8**. The reading unit **3** is used when reading an image of a document.

As shown in FIG. **4**, a first platen glass **81** and a second platen glass **82** are arranged on an upper surface of the main body unit **8**. An upper surface of the first platen glass **81** configures a document support surface **81**A. The document support surface **81**A supports a stationary document from below when the reading unit **3** reads an image of the document. The document to be read includes a sheet such as an OHP sheet, a book and the like. The second platen glass **82** is positioned at the left of the first platen glass **81** and is elongated in the front-rear direction. An upper surface of the second platen glass **82** configures a reading surface **82**A. When the reading unit **3** reads an image of the sheet SH being conveyed one at a time by the conveyor **4**, the reading surface **82**A guides the sheet SH from below.

As shown in FIG. **1**, the opening/closing unit **9** is swingably supported around an opening/closing shaft center X**9** extending in the left-right direction by hinges (not shown) arranged at a rear-side upper end of the main body unit **8**. At a closed state shown in FIGS. **1** to **4**, the opening/closing unit **9** is configured to cover the document support surface **81**A from above. Although not shown, the opening/closing unit **9** swings around the opening/closing shaft center X**9** so that a front end portion-side thereof is displaced upward and rearward. Thereby, the opening/closing unit **9** is displaced to an opened position at which the document support surface **81**A is exposed. Thereby, a user can make the document support surface **81**A support a document which is a read target.

As shown in FIG. **4**, the reading unit **3** includes a reading sensor **3**S accommodated at an upper part in the main body unit **8** and a scanning mechanism (not shown). The reading sensor **3**S is an example of the 'reading unit' of the disclosure. The scanning mechanism is configured to reciprocally move the reading sensor **3**S in the left-right direction below the document support surface **81**A and the reading surface **82**A in the main body unit **8**. As the reading sensor **3**S, a well-known image reading sensor such as a CIS (Contact Image Sensor) and a CCD (Charge Coupled Device) may be used.

As shown in FIGS. **2** to **4**, the conveyor **4** is provided at the opening/closing unit **9**. The conveyor **4** includes the feeder tray **91** and the discharge tray **92**. The feeder tray **91** is an example of the 'stacking part' of the disclosure. The feeder tray **91** is formed at a right part of the opening/closing unit **9** by opening a closed cover **9**C shown with a solid line in FIG. **1**, as shown with a dashed-two dotted line in FIG. **1**.

Also, as shown in FIG. **4**, the feeder tray **91** is formed by the opened cover **9**C and a chute member **93** positioned downstream from the cover **9**C in a conveying direction. An upper surface of the cover **9**C configures a part of a sheet support surface **91**A. The sheet support surface **91**A is configured to support a plurality of sheets SH, which are to be conveyed by the conveyor **4** and are reading targets, from below at a stacked state. The sheet support surface **91**A is formed by a first sheet support surface **9**A, which is an upwardly facing surface of the opened cover **9**C, and a second sheet support surface **93**A, which is a right part of an upper surface of the chute member **93**. The sheet support surface **91**A is a flat surface inclined leftward and downward. In this illustrative embodiment, a height direction orthogonal to the sheet support surface **91**A is a direction Dh indicated in FIGS. **4** and **7** to **9**. The height direction Dh is inclined relative to a vertical direction.

As shown in FIGS. **1** to **4**, the discharge tray **92** is positioned below the feeder tray **91** and is arranged to overlap vertically with the same. The sheet SH of which an image has been read by the reading sensor **3**S and has been discharged by the conveyor **4** is stacked on the discharge tray **92**.

As shown in FIGS. **2** and **4**, the conveyor **4** defines a conveyance path P**1**, as a space surrounded by guide surfaces extending to be contactable to one surface and the other surface of the sheet SH, conveying rollers (which will be described later) and the like. The conveyance path P**1** includes a part extending substantially horizontally leftward from a downstream end portion of the sheet support surface **91**A of the feeder tray **91** in the conveying direction. Then, the conveyance path P**1** includes a downwardly curved part. Then, the conveyance path P**1** includes a part extending shortly rightward along the reading surface **82**A. Finally, the conveyance path P**1** includes a part inclined rightward and upward from a downstream side of the reading surface **82**A in the conveying direction and reaching the discharge tray **92**.

A conveying direction of the sheet SH that is conveyed by the conveyor **4** is a leftward direction on the substantially horizontal upper part of the conveyance path P**1**, is changed from the leftward direction to a rightward direction on the downwardly curved part of the conveyance path P**1** and is a rightward direction on the lower part of the conveyance path P**1** passing through the reading surface **82**A and reaching the discharge tray **92**. In the meantime, the extending directions and shapes of the conveyance path P**1** are just exemplary.

As shown in FIGS. **4** to **9**, the conveyor **4** includes the chute member **93**, a supply roller **41**, a separation roller **42**, a separation piece **100**, a holding part **110**, an abutting part **120**, an inclined surface **130** and a film **170**. The separation piece **100** is an example of the 'flexible member' of the disclosure. The inclined surface **130** is an example of the 'restraint part' of the disclosure.

As shown in FIG. **4**, the chute member **93** is a resin-molded product of which an upper surface has a substantially flat plate shape. An area of the upper surface of the chute member **93** positioned at the left of the second sheet support surface **93**A is configured as a guide surface **93**B. More specifically, as shown in FIGS. **5** and **6**, a right end portion of the guide surface **93**B connects to a downstream end portion **91**E of the sheet support surface **91**A in the conveying direction, i.e., to

a left end portion of the second sheet support surface **93**A. The guide surface **93**B is inclined leftward and upward from the right end portion thereof and then extends substantially horizontally. As shown in FIG. **4**, the guide surface **93**B forms a flat surface that may abut on the sheet SH, which is fed from the feeder tray **91**, from below. The guide surface **93**B defines the substantially horizontal upper part of the conveyance path P**1** from below.

The separation roller **42** is provided to face the guide surface **93**B from above at a left position of the downstream end portion **91**E of the sheet support surface **91**A in the conveying direction. The separation roller **42** is mounted to a driving shaft **42**S having a shaft center X**42** extending in the front-rear direction, as a central axis. The separation roller **42** is a roller configured to rotate around the shaft center X**42** together with the driving shaft **42**S. That is, the separation roller **42** is provided to contact the sheet SH, which is fed from the feeder tray **91**, from an opposite side to the sheet support surface **91**A.

A holder **42**F is supported to the driving shaft **42**S so that the holder **42**F may swing around the shaft center X**42**. The holder **42**F protrudes rightward from the driving shaft **42**S.

The supply roller **41** is provided at a position at which it faces the second sheet support surface **93**A of the chute member **93** from above at the right of the separation roller **42**, i.e., at the upstream side of the separation roller **42** in the conveying direction. The supply roller **41** is supported to a right part of the holder **42**F so that it may rotate around a shaft center X**41** extending in the front-rear direction. That is, the supply roller **41** is provided to contact the sheet SH, which is supported on the sheet support surface **91**A of the feeder tray **91**, from an opposite side to the sheet support surface **91**A. Although not shown, the holder **42**F is provided with a transmission gear group (not shown) configured to transmit a rotational driving force from the driving shaft **42**S to the supply roller **41**.

As shown in FIGS. **4** and **7** to **9**, the holder **42**F is provided with an urging lever **42**L. An urging spring (not shown) is provided between the urging lever **42**L and the holder **42**F. When an upper end portion of the urging lever **42**L is urged to the urging spring and is pressed to an inner surface of an upper wall **9**D of the opening/closing unit **9**, the holder **42**F swings around the shaft center X**42** to bring the supply roller **41** close to the sheet support surface **91**A. Thereby, the supply roller **41** is enabled to come close to and to separate from the sheet support surface **91**A, depending on the number of the sheets SH supported on the sheet support surface **91**A, and is thus contacted to the uppermost sheet SH.

The supply roller **41** is configured to rotate around the shaft center X**41** to apply a conveying force to the uppermost sheet SH of the plurality of sheets SH supported on the sheet support surface **91**A of the feeder tray **91**, thereby supplying the corresponding sheet SH toward the separation roller **42**. The separation roller **42** is configured to rotate with contacting the sheet SH, which is fed from the supply roller **41**, i.e., from an upstream side in the conveying direction, thereby conveying the sheet SH leftward along the substantially horizontal upper part of the conveyance path P**1**, i.e., toward a downstream side in the conveying direction.

Here, as shown in FIGS. **3** and **4**, a right end portion of the upper wall **9**D of the opening/closing unit **9** is formed with a first wall part **191** and a second wall part **192**.

The first wall part **191** protrudes downwardly from a right end of the upper wall **9**D and extends in the front-rear direction. A central portion of the first wall part **191** in the front-rear direction is formed with a hand grip part **191**A recessed upwardly. When opening the upper wall **9**D for maintenance, a user may easily pull up the right end portion of the upper wall **9**D with putting a hand on the hand grip part **191**A.

The second wall part **192** protrudes downwardly from a position of the left of the first wall part **191** (a downstream side in the conveying direction) and the right of the holder **42**F and extends in the front-rear direction. A lower end **192**E of the second wall part **192** is located at a position lower than a lower end **191**E of the first wall part **191** and is closer to the sheet support surface **91**A. An interval between the lower end **192**E of the second wall part **192** and the sheet support surface **91**A is set so that a predetermined number of sheets may be inserted in the apparatus of the disclosure and foreign materials are prevented from being introduced therein.

By the first wall part **191** and the second wall part **192**, it is possible to prevent the foreign materials from being introduced in the vicinities of the holder **42**F and the supply roller **41** while increasing the number of stacked sheets SH supported on the sheet support surface **91**A.

As shown in FIGS. **5** and **6**, the chute member **93** has an opening **93**H. The opening **93**H is recessed in a direction getting away from the separation roller **42**, i.e., in a downward direction at the downstream end portion **91**E-side of the sheet support surface **91**A in the conveying direction. The opening **93**H includes at least a part of an area of the sheet support surface **91**A facing the separation roller **42**. Also, the opening **93**H includes a part extending leftward beyond the end portion **91**E of the sheet support surface **91**A and biting into the guide surface **93**B, and a part extending rightward beyond the end portion **91**E and biting into the second sheet support surface **93**A. A right area of the opening **93**H, which is formed at the second sheet support surface **93**A-side, is longer than the other areas in the front-rear direction.

As shown in FIG. **5**, the chute member **93** includes a small piece **94**. As shown in FIG. **6**, the chute member **93** is formed with a recess portion **93**J. The recess portion **93**J is positioned at a right end portion in the opening **93**H. As shown in FIGS. **5** and **6**, the small piece **94** is configured to be mounted to the chute member **93** so as to cover the recess portion **93**J from above and to be removable. As shown in FIGS. **5** and **7** to **9**, an upper surface **94**A of the small piece **94** forms a part of the sheet support surface **91**A at the downstream side. A lower surface **94**B of the small piece **94** extends in the left-right direction at a vertical interval from a bottom surface of the recess portion **93**J. The lower surface **94**B of the small piece **94** is an example of the 'opposite surface of the feeder tray to the sheet support surface' of the disclosure.

As shown in FIG. **5**, a left end of the small piece **94** configures an end portion **91**EE, which is a part of the downstream end portion **91**E of the sheet support surface **91**A in the conveying direction. That is, the end portion **91**EE, which faces the opening **93**H, of the downstream end portion **91**E of the sheet support surface **91**A in the conveying direction is positioned at the right of the other part of the end portion **91**E, i.e., at the upstream side in the conveying direction.

As shown in FIGS. **5** and **6**, front and rear inner wall surfaces of the opening **93**H are provided with a pair of front and rear recessed bearing parts **93**S, **93**S. Each of the bearing parts **93**S, **93**S is positioned in the vicinity of the end portion **91**E of the sheet support surface **91**A.

The abutting part **120** and the inclined surface **130** are formed integrally with the chute member **93** together with the sheet support surface **91**A.

The abutting part **120** is a rib protruding upwardly from a bottom of the opening **93**H. An upper end **120**A of the abutting part **120** extends in the front-rear direction. As shown in FIGS. **7** to **9**, the upper end **120**A of the abutting part **120** is configured to face the separation roller **42** from below. The

upper end **120**A of the abutting part **120** is located at a slight left position just below the shaft center X**42** of the separation roller **42**.

The inclined surface **130** is formed integrally with the abutting part **120** and is positioned at the right of the abutting part **120**, i.e., at the upstream side in the conveying direction. The inclined surface **130** is inclined rightward and downward from a position lower than the upper end **120**A of the abutting part **120**. In other words, the inclined surface **130** is inclined to be more spaced from the separation roller **42** as it faces upstream in the conveying direction.

As shown in FIGS. **5** to **9**, the separation piece **100** is flexible. In this illustrative embodiment, the separation piece **100** is a rectangular plate member made of rubber. The separation piece **100** extends in the left-right direction below the separation roller **42**. The separation piece **100** includes a first end portion **101** and a second end portion **102**.

The first end portion **101** is a right end portion of the separation piece **100** and the second end portion **102** is a left end portion of the separation piece **100**. In other words, the first end portion **101** of the separation piece **100** is positioned upstream in the conveying direction, and the second end portion **102** is positioned downstream in the conveying direction.

As shown in FIG. **6**, the first end portion **101** of the separation piece **100** is formed with a long hole **101**H penetrating in the upper-lower direction. The long hole **101**H extends in the left-right direction. A cylindrical protrusion **93**T protrudes from a center of the bottom of the recess portion **93**J of the chute member **93**.

As shown in FIGS. **7** to **9**, the first end portion **101** of the separation piece **100** is configured to abut on the bottom of the recess portion **93**J from above with the protrusion **93**T being inserted into the long hole **101**H. By this configuration, the first end portion **101** of the separation piece **100** may move in the left-right direction. The first end portion **101** of the separation piece **100** is positioned at the lower surface **94**B of the small piece **94**. More specifically, the first end portion **101** of the separation piece **100** includes a part **101**L that gets into a below of the lower surface **94**B of the small piece **94**, extends toward the right end of the opening **93**H, i.e., the upstream side in the conveying direction and is arranged with overlapping with the feeder tray **91** in the direction Dh orthogonal to the sheet support surface **91**A. That is, the first end portion **101** of the separation piece **100** is restrained from being pulled out from the protrusion **93**T by the small piece **94** configured to cover the recess portion **93**J. As shown in FIG. **6**, the recess portion **93**J includes front and rear inner wall surfaces **93**K. The first end portion **101** of the separation piece **100** is restrained from positionally deviating in the front-rear direction by the front and rear inner wall surfaces **93**K shown in FIG. **6**.

As shown in FIGS. **4** and **7** to **9**, the second end portion **102** of the separation piece **100** extends up to the left of the shaft center X**42** of the separation roller **42** and is configured to face the separation roller **42** from below. The second end portion **102** of the separation piece **100** is fixed to the holding member **110**.

As shown in FIGS. **7** to **9**, the upper end **120**A of the abutting part **120** is configured to abut on the separation piece **100** from below, i.e., from the opposite side to the separation roller **42** at an intermediate position N**1** between the right first end portion **101** of the separation piece **100** and the left second end portion **102** of the separation piece **100**. Here, a height of the upper end **120**A of the abutting part **120** is set to secure a gap between the separation roller **42** and the separation piece **100** at the intermediate position N**1** so that the sheet SH can pass therethrough.

As shown in FIGS. **5** and **6**, the holding member **110** is a resin-molded product having a base part **111** and a front protrusions **112** and a rear protrusions **112**.

The base part **111** has a substantially rectangular plate shape. The base part **111** is curved to conform to an outer peripheral surface of the separation roller **42**. The second end portion **102** of the separation piece **100** is attached to an upper surface of the base part **111** by a double-sided tape, and the like. That is, the second end portion **102** of the separation piece **100** is attached to the holding member **110**.

The front protrusion **112** protrudes forwardly from a front-right angled part of the base part **111**, is bent and protrudes rightward. The rear protrusion **112** protrudes rearward from a rear-right angled part of the base part **111**, is bent and protrudes rightward. Right end portions of the respective protrusions **112**, **112** are formed with shaft parts **112**S, **112**S. The front shaft part **112**S and the rear shaft part **112**S are cylindrical shaft members each of which has a swinging shaft center X**110** extending in the front-rear direction, as a central axis. The front shaft part **112**S and the rear shaft part **112**S protrude in directions getting away from each other. As shown in FIG. **5**, the swinging shaft center X**110** is positioned in the vicinity of the end portion **91**E of the sheet support surface **91**A.

As shown in FIG. **6**, the respective shaft parts **112**S, **112**S of the holding member **110** are fitted in the respective bearing parts **93**S, **93**S of the chute member **93**, so that the holding member **110** is supported to the chute member **93** to be swingable around the swinging shaft center X**110**. By this configuration, the base part **111** of the holding member **110** may come close to and separate from the separation roller **42** by vertically moving at the left of the abutting part **120**.

As shown in FIGS. **4** to **6**, a compression coil spring **110**S is arranged between the base part **111** of the holding member **110** and the bottom of the opening **93**H of the chute member **93**. The compression coil spring **110**S is configured to urge the base part **111** upwardly, so that the second end portion **102** of the separation piece **100** is urged toward the separation roller **42**.

As shown in FIGS. **5** to **9**, the separation piece **100** has an auxiliary support surface **103** and a friction surface **105**. The auxiliary support surface **103** is a part of n upper surface of the separation piece **100**, which is positioned at the right of the intermediate position N**1**, i.e., at an upstream side in the conveying direction. The friction surface **105** is a part of the upper surface of the separation piece **100**, which is positioned at the left of the intermediate position N**1**, i.e., at a downstream side in the conveying direction. As shown in FIG. **5**, the second end portion **102** of the separation piece **100** is attached to the holding member **110** with the auxiliary support surface **103** and the friction surface **105** being exposed from the opening **93**H.

As shown in FIGS. **5** and **7** to **9**, the auxiliary support surface **103** extends toward the separation roller **42** from a vicinity of the end portion **91**EE, which faces toward the opening **93**H, of the downstream end portion **91**E of the sheet support surface **91**A in the conveying direction. The auxiliary support surface **103** can be bent in a direction getting away from the separation roller **42**, i.e., downwardly between the first end portion **101** and the abutting part **120**. A surface of the separation piece **100** facing toward an opposite side to the auxiliary support surface **103** is configured as a restrained surface **109**.

As shown in FIG. **7**, the inclined surface **130** is configured to face the restrained surface **109** from below at an interval in the upper-lower direction. As shown in FIG. **9**, the inclined surface **130** abuts on the restrained surface **109** to restrain a bending range of the auxiliary support surface **103** when the bending of the auxiliary support surface **103** becomes large. At this time, the restrained surface **109** conforms to and abuts on the inclined surface **130**, so that an inclined angle of the auxiliary support surface **103** is restrained from being excessively large.

As shown in FIG. **6**, regarding the film **170**, a resin sheet having high stiffness and smooth surface such as a polyester film is used. A right end portion of the film **170** is formed with a long hole **170**H penetrating therethrough. As shown with a dashed-two dotted line in FIG. **5**, the film **170** extends leftward along the auxiliary support surface **103**, i.e., toward the downstream side in the conveying direction from a vicinity of the end portion **91**EE, which faces toward the opening **93**H, of the downstream end portion **91**E of the sheet support surface **91**A in the conveying direction. The film **170** may be attached to the auxiliary support surface **103** by a double-sided tape, and the like.

As shown in FIGS. **7** to **9**, the film **170** is configured to abut on the separation piece **100** from above with the protrusion **93**T protruding from the recess portion **93**J of the chute member **93** being inserted in the long hole **170**H. The right end portion of the film **170** is restrained from being pulled out from the protrusion **93**T by the small piece **94** configured to cover the recess portion **93**J. The right end portion **101** of the film **170** is restrained from positionally deviating in the front-rear direction by the front and rear inner wall surfaces **93**K of the recess portion **93**J shown in FIG. **6**. By this configuration, the right end portion of the film **170** may move in the left-right direction together with the first end portion **101** of the separation piece **100**.

As shown in FIGS. **5** and **7** to **9**, a downstream tip end **170**E of the film **170** in the conveying direction is located at the right of the friction surface **105** and the abutting part **120**, i.e., at an upstream side in the conveying direction.

As shown in FIGS. **7** to **9**, the auxiliary support surface **103** is configured to support a downstream end portion SH**1** of the sheet SH in the conveying direction, which is supported on the sheet support surface **91**A, with the film **170** being interposed. At this time, as shown in FIG. **7**, when the number of stacked sheets SH is small, the auxiliary support surface **103** is not bent so much. On the other hand, as shown in FIG. **8**, when the number of stacked sheets SH is large, the downstream end portions SH**1** of the sheets SH in the conveying direction are contacted to a high position (a position distant from the separation piece **100**) of the outer peripheral surface of the separation roller **42**. At this time, the auxiliary support surface **103** is pushed by the sheets SH and is thus bent downwardly. As shown in FIG. **9**, when the supply roller **41** and the separation roller **42** are rotated, a downward force is applied to the end portions SH**1** of the sheets SH from the separation roller **42** and the auxiliary support surface **103** is further bent downwardly by the downward force. As a result, as can be seen from a comparison of FIGS. **7** and **9**, a trajectory along which the uppermost sheet SH supported on the sheet support surface **91**A faces toward a gap between the separation roller and the separation piece at the intermediate position N**1** is stable, irrespective of whether the number of sheets SH supported on the sheet support surface **91**A is large or small. At this time, since the end portion SH**1** of the sheet SH supported on the auxiliary support surface **103** is contacted to the auxiliary support surface **103** with the flat film **170** being interposed, the sheet SH can be prevented from being caught at the auxiliary support surface **103**.

The friction surface **105** is formed by the surface of the rubber plate material configuring the entire separation piece **100**. When the second end portion **102** of the separation piece **100** is urged toward the separation roller **42** by the holding member **110** and the compression coil spring **110**S, the friction surface **105** is bent downwardly between the abutting part **120** and the second end portion **102** and is pressed to the outer peripheral surface of the separation roller **42**. When the plurality of sheets SH is conveyed from the supply roller **41** to the separation roller **42** with being stacked, the separation piece **100** separates the sheets one at a time in cooperation with the separation roller **42** and the friction surface **105**.

As shown in FIG. **4**, the conveyor **4** includes a large diameter conveying roller **45**, a curved guide surface **45**G and pinch rollers **45**P, **45**Q at the downwardly curved part of the conveyance path P**1**. An outer peripheral surface of the conveying roller **45** is configured to form an inner guide surface of the downwardly curved part of the conveyance path P**1**. The curved guide surface **45**G is arranged at a predetermined interval from the outer peripheral surface of the conveying roller **45**. The curved guide surface **45**G is configured to form an outer guide surface of the downwardly curved part of the conveyance path P**1**. The conveying roller **45** is configured to convey the sheet SH toward the reading surface **82**A in cooperation with the pinch rollers **45**P, **45**Q abutting on the outer peripheral surface of the conveying roller **45**.

The conveyor **4** includes a pressing member **49** at a position facing the reading surface **82**A from above. The pressing member **49** is configured to press the sheet SH, which is being conveyed from the conveying roller **45**, from above, thereby bringing the same into contact with the reading surface **82**A.

The conveyor **4** includes a discharge roller **48** and a pinch roller **48**P at the upwardly inclined part of the conveyance path P**1** at the right of the pressing member **49**. The discharge roller **48** and the pinch roller **48**P are configured to face toward the discharge tray **92**. The discharge roller **48** and the pinch roller **48**P are configured to discharge the sheet SH having passed above the reading surface **82**A toward the discharge tray **92**.

<Image Reading Operation>

According to the image reading apparatus **1**, when reading an image of a document supported on the document support surface **81**A, the scanning mechanism (not shown) of the reading unit **3** is operated to move the reading sensor **3**S in the left-right direction between a lower position of a left end of the document support surface **81**A and a lower position of a right end thereof. Thereby, the reading sensor **3**S reads the image of the document supported on the document support surface **81**A. Thereafter, the scanning mechanism (not shown) returns the reading sensor **3**S having completed the reading to the original position by moving the same from the right end to the left end in the reading unit **3**.

Also, according to the image reading apparatus **1**, when reading an image of the sheet SH on the feeder tray **91**, the scanning mechanism (not shown) of the reading unit **3** is operated to stop the reading sensor **3**S at a predetermined reading position of the reading surface **82**A. The reading sensor **3**B located at the predetermined reading position is positioned downstream from the separation roller **42** in the conveying direction. When the conveyor **4** sequentially conveys the sheets SH on the feeder tray **91** along the conveyance path P**1**, the sheet SH passes above the reading sensor **3**S located at the predetermined reading position with contacting the reading surface **82**A. Therefore, the reading sensor **3**S reads an image of the passing sheet SH. Then, the sheet SH of

which an image has been read is discharged to the discharge tray **92** by the discharge roller **48** and pinch roller **48**P.

According to the image reading apparatus **1** of the illustrative embodiment, as shown in FIGS. **7** to **9**, the upper end **120**A of the abutting part **120** is configured to abut on the separation piece **100** from below, i.e., from the opposite side to the separation roller **42** at the intermediate position N**1** between the first end portion **101** and the second end portion **102** in the conveying direction. The separation piece **100** has the auxiliary support surface **103** at the upstream side from the intermediate position N**1** in the conveying direction. The separation piece **100** has the friction surface **105** at the downstream side from the intermediate position N**1** in the conveying direction. That is, the upper end **120**A of the abutting part **120** is configured to abut on the separation piece **100** between the auxiliary support surface **103** and the friction surface **105**, thereby restraining the auxiliary support surface **103** and the friction surface **105** from influencing each other. Thereby, according to the image reading apparatus **1**, as shown in FIG. **9**, when the number of stacked sheets SH supported on the sheet support surface **91**A increases, the auxiliary support surface **103** of the separation piece **100** is appropriately bent downwardly, i.e., toward the direction getting away from the separation roller **42**, thereby suppressing a positional relation between the sheet SH and the separation roller **42** from being a position unsuitable for the conveyance of the sheet SH. Thereby, according to the image reading apparatus **1**, it is possible to suppress a problem in the conveyance of the sheet SH. Also, according to the image reading apparatus **1**, the abutting part **120** is provided. Therefore, the positional relation between the separation roller **42** and the separation piece **100** is held to a position suitable for the separation of the sheets SH. For this reason, according to the image reading apparatus **1**, even when the auxiliary support surface **103** of the separation piece **100** is bent in the direction getting away from the separation roller **42**, it is possible to suppress the bending of the auxiliary support surface **103** from displacing the friction surface **105** in the direction getting away from the separation roller **42** or from deforming the friction surface **105**. For this reason, according to the image reading apparatus **1**, a nipped state between the separation roller **42** and the friction surface **105** of the separation piece **100**, for example, an inclined angle of the friction surface **105** of the separation piece **100** relative to the separation roller **42** or a pressing force thereof is hardly varied. As a result, according to the image reading apparatus **1**, it is possible to separate the sheets SH, which are fed from the feeder tray **91**, with high precision between the separation roller **42** and the friction surface **105** of the separation piece **100**.

Therefore, according to the image reading apparatus **1** of the illustrative embodiment, it is possible to exhibit the stable separation performance, irrespective of whether the number of stacked sheets SH supported on the sheet support surface **91**A is large or small. As a result, it is possible to reduce problems such as multi feed of sheets SH and unloaded feed of the sheet in the image reading apparatus **1**.

Also, according to the image reading apparatus **1**, the entire separation piece **100** is formed of the rubber, which is a frictional material configuring the friction surface **105**. For this reason, according to the image reading apparatus **1**, it is possible to simplify the separation piece **100** and to save the manufacturing cost of the separation piece **100**.

Further, according to the image reading apparatus **1**, as shown in FIG. **5**, the second end portion **102** of the separation piece **100** is attached to the holding member **110** with the auxiliary support surface **103** and the friction surface **105** being exposed from the opening **93**H. Thereby, according to the image reading apparatus **1**, it is possible to easily implement a configuration enabling the auxiliary support surface **103** of the separation piece **100** to be bent in the direction getting away from the separation roller **42**.

Also, according to the image reading apparatus **1**, as shown in FIGS. **7** to **9**, the first end portion **101** includes the part **101**L that gets into the below of the opposite surface of the feeder tray **91** to the sheet support surface **91**A, i.e., the lower surface **94**B of the small piece **94**, extends toward the right end side of the opening **93**H, i.e., the upstream side in the conveying direction and is arranged with overlapping with the feeder tray **91** in the direction Dh orthogonal to the sheet support surface **91**A. For this reason, according to the image reading apparatus **1**, even when the first end portion **101** is moved leftward from the position shown in FIG. **7**, as shown in FIG. **9**, as the auxiliary support surface **103** is bent, the state where the first end portion **101** is covered by the lower surface **94**B of the small piece **94** is kept. For this reason, according to the image reading apparatus **1**, it is possible to prevent a situation where the first end portion **101** is pulled out toward the separation roller **42** and the separation piece **100** is thus rolled up.

Further, according to the image reading apparatus **1**, as shown in FIG. **9**, the inclined surface **130** serving as the restraint part is configured to abut on the restrained surface **109**, thereby restraining the bending range of the auxiliary support surface **103** and the inclined angle of the auxiliary support surface **103** from being excessively large. For this reason, according to the image reading apparatus **1**, it is possible to suppress the auxiliary support surface **103** from being excessively bent to deform the friction surface **105**. Also, according to the image reading apparatus **1**, it is possible to suppress the auxiliary support surface **103** from being excessively bent or the inclined angle from being excessively large and the sheet SH from being thus caught at the auxiliary support surface **103**. As a result, according to the image reading apparatus **1**, it is possible to securely suppress the deterioration of the separation performance. Also, since the inclined surface **130** is shaped in conformity to the bent shape of the auxiliary support surface **103**, the inclined surface **130** may more easily exhibit the function of the restraint part.

Further, according to the image reading apparatus **1**, as shown in FIG. **6**, the abutting part **120**, which is a rib, and the inclined surface **130** are formed integrally with the chute member **93**, together with the sheet support surface **91**A. For this reason, according to the image reading apparatus **1**, it is possible to simplify a mounting operation, as compared to a configuration where the abutting part **120** and the inclined surface **130** are configured as separate members from the chute member **93** configuring the feeder tray **91**. Also, according to the image reading apparatus **1**, the abutting part **120** and the inclined surface **130** are formed integrally with the chute member **93**, so that it is possible to arrange the abutting part **120** and the inclined surface **130** at stable positions with respect to the separation roller **42**.

Also, according to the image reading apparatus **1**, as shown in FIGS. **7** to **9**, the sheet SH supported on the auxiliary support surface **103** is conveyed downstream in the conveying direction with sliding-contacting the film **170** on which the sheet may easily slide. For this reason, according to the image reading apparatus **1**, even when the auxiliary support surface **103** is bent, the sheet SH can be prevented from being caught at the auxiliary support surface **103**. Also, since the downstream tip end **170**E of the film **170** in the conveying direction is positioned upstream from the friction surface **105** in the conveying direction, the film **170** has difficulty in influencing the separation performance.

Further, according to the image reading apparatus **1**, the separation roller **42** and the friction surface **105** of the separation piece **100** exhibit the stable separation performance, so that it is possible to stabilize a reading quality of the reading sensor **3**S configured to read an image of the separated sheet SH.

Although the disclosure has been described with reference to the illustrative embodiment, the disclosure is not limited to the illustrative embodiment and can be appropriately changed without departing from the gist thereof.

For example, regarding the material configuring the friction surface, a frictional material such as rubber, elastomer, sponge and the like may be adopted. The flexible member may be configured by bonding a frictional material configuring a friction surface to a flexible resin plate by an adhesive or double-sided tape and integrating the same. Also, a frictional material configuring a friction surface and a soft material such as a soft resin may be integrated by a two-color molding. Also, the entire flexible member may be configured by the frictional material such as rubber, elastomer, sponge and the like.

In the above illustrative embodiment, the restraint part is configured by the inclined surface **130**. However, the disclosure is not limited thereto. For example, the restraint part may be a convex part, a stepped portion, a rib and the like.

The disclosure can be applied to an image reading apparatus, an image forming apparatus, a complex machine and the like.

What is claimed is:

1. A sheet separating apparatus comprising:

a chute member comprising a stacking part including a sheet support surface configured to support a sheet;

a separation roller configured to convey the sheet supported on the sheet support surface toward a downstream side in a conveying direction;

a flexible member having flexibility and comprising:

a first end portion positioned upstream in the conveying direction and being displaceable;

a second end portion positioned downstream in the conveying direction and facing the separation roller, a first surface of the flexible member facing the separation roller; and

a hole extending in the conveying direction at the first end portion;

a holding member to which the second end portion of the flexible member is attached;

an abutting part configured to abut on a second surface, which is opposite to the first surface, of the flexible member at an intermediate position between the first end portion and the second end portion in the conveying direction; and

a protrusion protruding from the chute member toward the flexible member and being inserted into the hole of the flexible member such that the first end portion of the flexible member is allowed to move in the conveying direction within a predetermined range,

wherein the flexible member comprises:

an auxiliary support surface provided upstream from the intermediate position in the conveying direction and configured to support a downstream end portion of the sheet supported on the sheet support surface in the conveying direction, wherein the auxiliary support surface is bendable in a direction getting away from the separation roller in response to the flexible member being moved in the conveying direction while the abutting part maintains abutting on the second surface of the flexible member; and

a friction surface provided downstream from the intermediate position in the conveying direction and configured to face the separation roller to be contactable with the separation roller, wherein the friction surface is configured to separate the sheet one at a time in cooperation with the separation roller.

2. The sheet separating apparatus according to claim **1**, wherein the flexible member is entirely formed of a material configuring the friction surface.

3. The sheet separating apparatus according to claim **1**,

wherein the stacking part comprises an opening, the opening comprising at least a part of an area of the sheet support surface, which is positioned downstream in the conveying direction and faces the separation roller, and being recessed in the direction getting away from the separation roller, and

wherein the second end portion of the flexible member is attached to the holding member with the auxiliary support surface and the friction surface being exposed from the opening.

4. The sheet separating apparatus according to claim **3**, wherein the first end portion comprises a part that is positioned at an opposite surface-side of the stacking part to the sheet support surface, extends upstream from the opening in the conveying direction and is arranged with overlapping with the stacking part in a direction orthogonal to the sheet support surface.

5. The sheet separating apparatus according to claim **4**, further comprising:

a piece that covers an upstream side of the opening, an upper surface of the piece forming a part of the sheet support surface at a downstream side in the conveying direction.

6. The sheet separating apparatus according to claim **3**, further comprising:

a piece that covers an upstream side of the opening, an upper surface of the piece forming a part of the sheet support surface at a downstream side in the conveying direction,

wherein the first end portion comprises a part that extends upstream from the opening in the conveying direction and gets into a below of a lower surface of the piece so as to overlap with the stacking part in a direction orthogonal to the sheet support surface.

7. The sheet separating apparatus according to claim **1**, further comprising:

a restraint part provided to be contactable with the second surface of the flexible member to the auxiliary support surface and configured to limit a bending range of the auxiliary support surface.

8. The sheet separating apparatus according to claim **7**, wherein the restraint part is an inclined surface that is positioned upstream from the abutting part in the conveying direction and is inclined to be more spaced from the separation roller toward upstream in the conveying direction.

9. The sheet separating apparatus according to claim **8**,

wherein the abutting part and the inclined surface are formed integrally with the stacking part together with the sheet support surface,

wherein the abutting part is a rib protruding toward the separation roller, and

wherein the inclined surface is inclined lower toward upstream from the abutting part in the conveying direction.

10. The sheet separating apparatus according to claim 1, further comprising:

a film extending along the auxiliary support surface toward a downstream side in the conveying direction,

wherein a downstream tip end of the film in the conveying direction is positioned upstream from the friction surface in the conveying direction.

11. The sheet separating apparatus according to claim 1, further comprising:

a reading unit provided downstream from the separation roller in the conveying direction and configured to read an image of the sheet separated one at a time by the separation roller and the friction surface.

12. The sheet separating apparatus according to claim 1,

wherein the protrusion is positioned upstream from the abutting part in the conveying direction, and

wherein the protrusion protrudes from a bottom of a recess of the chute member.

13. The sheet separating apparatus according to claim 1, wherein the first end portion of the flexible member is allowed to move in the downstream side in the conveying direction when the flexible member is bent in the direction getting away from the separation roller.

14. The sheet separating apparatus according to claim 1,

wherein the flexible member is configured to be bent in the direction getting away from the separation roller by the auxiliary support surface being pressed by the downstream end portion of the sheet applied with a force generated by a rotation of the separation roller.

15. The sheet separating apparatus according to claim 1, further comprising:

a supply roller provided at an upstream side of the separation roller in the conveying direction and configured to supply the sheet toward the separation roller.

16. The sheet separating apparatus according to claim 1,

wherein the chute member comprises an opening, and

wherein the sheet separating apparatus further comprises a spring arranged between a bottom of the opening and the holding member for urging the second end portion of the flexible member toward the separation roller via the holding member.

17. The sheet separating apparatus according to claim 1, wherein the first surface of the flexible member comprises the auxiliary support surface and the friction surface.

18. The sheet separating apparatus according to claim 1,

wherein the abutting part is formed integrally with the stacking part.

19. The sheet separating apparatus according to claim 1, further comprising:

a restraint part configured to limit a bending range of the auxiliary support surface, the second surface of the flexible member being contactable to and separatable from the restraint part at upstream from the intermediate position in the conveying direction.

20. The sheet separating apparatus according to claim 1,

wherein the auxiliary support surface is bendable in a direction getting away from the separation roller in response to the flexible member being moved in the downstream side in the conveying direction while the abutting part maintaining abutting on the second surface of the flexible member, and

wherein the auxiliary support surface is bendable in a direction coming closer to the separation roller in response to the flexible member being moved in an upstream side in the conveying direction while the abutting part maintaining abutting on the second surface of the flexible member.

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